

1. Specify: ☒ Agricultural Project ☒ Individual Application
2. Proposal Title: KERN-TULARE WATER DISTRICT  
WATER USE EFFICIENCY PROJECT
3. Principal Applicant: KERN-TULARE WATER DISTRICT
4. Contact: Steven C. Dalke, General Manager
5. Mailing Address: 1820 21<sup>st</sup> Street, Bakersfield, CA 93301
6. Telephone: (661) 327-3132
7. Fax: (661) 327-2724
8. E-mail: ktrgwd@lightspeed.net
9. Funds requested – dollar amount: \$4,000,000
10. Applicant cost share funds pledged - dollar amount: \$4,000,000
11. Duration—(month/year to month/year): August 1, 2001 to March 1, 2002
12. State Assembly and Senate districts and Congressional district(s) where the project is to be conducted:  
  
California 32<sup>nd</sup> Assembly District, California 16<sup>th</sup> Senate District
13. Location and geographic boundaries of the project: Kern-Tulare Water District and Rag Gulch Water District (see attached map)
14. If this project is not selected for funding under this PSP, do you want the proposal to be forwarded to other CALFED funding agencies? Yes X No
15. Name and signature of official representing applicant. By signing below, the applicant declares the following:  
  
       the truthfulness of all representations in the proposal;  
       the individual signing the form is authorized to submit the application on behalf of the applicant;  
       the applicant will comply with contract terms and conditions identified in Section 11 of this PSP

Steven C. Dalke, General Manager

February 12, 2001

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Signature of Applicant

## **B. Scope of Work**

### ***Relevance and Importance***

#### **1. Abstract (Executive Summary).**

Kern-Tulare Water District and Rag Gulch Water District (the Districts) share common distribution systems and staff. This proposal for a grant under the CALFED Water Use Efficiency Program is being submitted on behalf of both Districts, with Kern-Tulare as the lead agency.

The Districts provide agricultural water service to about 20,000 acres of high-value permanent crops (predominately grapes, citrus, and nuts) located east of Delano in Kern and Tulare Counties. The Districts facilities consist of 15 pumping plants and approximately 70 miles of pressure pipeline to deliver water upslope from the Friant-Kern Canal. The annual irrigation demand is approximately 71,000 acre-feet, of which the Districts have historically provided approximately 43,000 acre-feet. The remaining 28,000 acre-feet is provided by groundwater pumped by water users.

The Districts have contracts with the United States to export up to 53,300 acre-feet of CVP water south of the delta. The Districts also have contracts with the City of Bakersfield for an average of 23,000 acre-feet per year of Kern River water. Prior to the formation of the Districts, groundwater levels were falling at an average rate of 15 feet per year. As a result of importation of District water into the area, groundwater levels are currently stable.

The primary purpose of the proposed project is to increase irrigation efficiency through increased flexibility in water ordering and expansion the Districts' conjunctive use program. Other incidental benefits of the project are reduced energy use and improved groundwater conditions.

The above objectives can be obtained by expanding the Districts' distribution system delivery capability and flexibility. These improvements will enable water users to reduce reliance on groundwater in years of adequate water supply, which will result in improved groundwater levels for use during years of reduced surface water supplies.

## 2. Statement of Critical Issues

As a result of increasing environmental actions in the delta, the Districts actual water supply is only a fraction of what it once was. This reduced water supply to the Districts will lead to inadequate water supplies to permanent crops during dry years and will cause further lowering of groundwater levels.

District staff manually operates the distribution system. As a result, water users must place water orders a minimum of 24 hours in advance and changes are made only once per day. This causes water users to continue to take delivery of water for the remainder of the 24-hour period, even if the irrigation has been completed. In addition, the distribution system is undersized and water deliveries are prorated during the peak four months of the summer. Enforcing prorates to water users requires that the Districts' turnouts remain locked and are operated only by District personnel. In order to allow for the water users to operate their own turnouts and avoid the 24-hour notice requirement, the Districts' distribution system capacity and flexibility must be increased.

The proposed project is consistent with the Districts' Groundwater Management Plan, the Districts' water conservation program, and the Districts' integrated resources plan. The proposed project will also help meet CALFED goals of reducing pumping from the Delta by providing the Districts with the means to take delivery of more water during years of adequate supply and less reliance upon imported water during dry years.

3. Nature, Scope and Objectives of the project.

The scope of the project includes installation of a SCADA system to operate and monitor the Districts' distribution system and construction of upgrades to the distribution system to increase delivery capability and flexibility. This increase in delivery capability will be to better serve lands already in the Districts service area and not to bring additional lands into production.

The primary objective of this project is to improve irrigation efficiency through 1) increased flexibility in water ordering, and delivery to, water users and 2) Optimize conjunctive use of surface water and groundwater. In addition to the primary objective, the project will result in an increase in energy efficiency.

***Technical/Scientific Merit Feasibility, Monitoring, and Assessment***

4. Methods, procedures, and facilities.

The Districts distribution system currently has the capacity to deliver 3.7 gpm per acre to customer turnouts. As a result of this limited delivery capability, District water deliveries are prorated during the peak irrigation season and water users are forced to supplement District water with water produced from privately owned wells. It is estimated that by increasing the delivery capability of the distribution system to 4.8 gpm per acre that extraction from privately owned wells could be reduced from 28,000 to 13,000 during years of adequate District surface water supplies.

Prior to the formation of the Districts and the importation of surface water, groundwater levels were falling at an average rate of 15 feet per year. Since importation of surface water, water levels have risen and are currently stable. This trend illustrates the direct impact upon groundwater levels and imported surface water supply.

Observation of groundwater levels and review of reports indicates that a cone of depression exists beneath the Districts that causes groundwater to flow into the District from both the east and the west. The presence of this groundwater depression makes the District an ideal candidate for further expansion of the conjunctive use of groundwater. Specifically, groundwater that is recharged by increasing surface water supplies and reducing well extraction will stay beneath the District.

The facilities required for the project includes installation of a SCADA system to operate and monitor the Districts' distribution system and construction of upgrades to the distribution system to increase delivery capability and flexibility. Attached, as Figure 1, is a map of the Districts' distribution system which indicates the locations of proposed upgrades. A description of each of these upgrades is provided below.

#### SCADA System

As previously described, District personnel manually operate the Districts distribution system. Changes in delivery flow rates to water users are made each morning between 7 and 9 a.m. District personnel are then required to physically drive to pumping plants, reservoirs, and turnouts throughout the day to verify flow rates, pressures, and water levels. In order to change district policy to allow for water users to make deliveries at any time, the District must have increased abilities to monitor pumping plants and reservoirs from a remote site. The proposed SCADA system, in combination with other distribution system improvement will accomplish this objective.

#### Avenue 9 Pumping Plant and Pipeline

This portion of the project involves construction of a 1,300 horsepower pumping plant and 4.5 miles of 36-inch pipeline and 1.5 miles of 27-inch pipeline from the Friant-Kern Canal to the Districts' two main reservoirs (Cecil and Big 4). The purpose of this facility is to increase delivery capability and flexibility of the Lake Woollomes and Cecil distribution systems.

### Cecil Reservoir Pumping Plant

This portion of the project involves construction of a 400 horsepower pumping plant at Cecil Reservoir, construction of 1.5 miles of 24-inch pipeline, 0.75 miles of 12-inch pipeline, and abandonment of the Pit, Little Twins and Avenue 4 pumping plants. The new pumping plant would be a state-of-art energy efficient pumping plant equipped with a VFD and would replace three inefficient and outdated pumping plants. The purpose of the new pipeline and pumping plant is to increase the delivery capability of the existing Pit and Little Twins distribution systems.

### Installation of VFD electrical controls

VFD electrical controls will be added to the following existing pumping plants.

- Elmo
- 6<sup>th</sup> Booster
- Twin Pipes

The purpose of these facilities is to automate existing pumping plants such that they automatically maintain a constant pressure in the pipeline. This will allow for water users to make changes to their delivery rates without impacting other water users on the pipeline, while reducing the risk of over-pressuring and damaging of District facilities.

### Improvements to Avenue 24 and Avenue 36 Distribution systems

Improvements to the Avenue 24 and Avenue 36 Distribution systems include the following.

- Construction of 1 mile of a 24-inch pipeline interconnecting the Avenue 24 and Avenue 36 distribution systems.
- Addition of 800 horsepower to the existing Avenue 36 pumping plant.
- Expand the capacity of the Avenue 24 Reservoir from 12 acre-feet to 60 acre-feet.
- Abandonment of Avenue 40 pumping plant.

The purpose of these improvements is to increase delivery capability and flexibility of Avenue 24, Avenue 36 and Avenue 40 distribution systems.

## 5. Schedule.

Certain elements of the project can begin immediately, such as finalization of design and preparation of specifications. Once the Districts receive notice that funding is available, contracts can be let and parts will be ordered. The largest portion of the project (the Avenue 9 Pumping Plant and Pipeline) can be constructed anytime of year, however, connections or modifications to existing distribution systems must be made during the winter. Attached as Figure 2, is a bar chart with tasks, deliverable items and due dates.

As shown on the Figure 2, work on the project will begin April 1, 2001 and the entire project will be completed on March 1, 2002

## 6. Monitoring and assessment.

The Districts will submit project reports (fiscal and programmatic) on a quarterly basis and file a final report upon the completion of the project. In the Quarterly Progress Report, information will be included on the completion percentage of each task and any issues that might prevent the work from being completed on schedule. In addition, the Districts will submit an annual written monitoring report presenting findings and addressing project progress. Upon request, the Districts will provide oral or written presentations regarding project status and findings.

The Districts keep records of monthly water deliveries served through each turnout and perform an annual crop survey. This information will be used to assess the success of the project by comparing pre- and post-project water deliveries in acre-feet per acre. Additionally, information collected on groundwater levels will be an indication of the success of the project. As part of the Districts' Groundwater Monitoring Program, groundwater level information will be summarized to show changes over time. Additionally, water levels will be evaluated periodically to determine the direction of groundwater flow.

Water Use Efficiency Program  
Project Schedule

Task	Cost	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02
SCADA System	\$ 420,000	140,000	140,000	140,000									
Avenue 9 Pumping Plant and Pipeline													
Friant-Kern Canal Turnout	\$ 200,000							200,000					
1,000 HP Pumping Plant	\$ 1,040,000											520,000	520,000
36" Pipeline	\$ 1,920,000							480,000	480,000	480,000	480,000		
27" Pipeline	\$ 480,000							480,000					
Highway Crossing	\$ 100,000								100,000				
County Road Crossing	\$ 100,000									100,000			
Reservoir Connection	\$ 60,000										60,000		
Cecil Reservoir Pumping Plant													
Pumping Plant	\$ 320,000					160,000	160,000						
24" Pipeline	\$ 400,000					400,000							
12" Pipeline	\$ 80,000					80,000							
Interconnections	\$ 20,000						20,000						
Installation of VFD Electrical Controls													
Elmo	\$ 50,000	50,000											
6th Booster	\$ 25,000		25,000										
Twin Pipes	\$ 30,000			30,000									
Improvements to Avenue 24 and Avenue 36 Distribution Systems													
24" Pipeline	\$ 260,000	86,667	86,667	86,667									
Additional Pumps	\$ 70,000				70,000								
Modify Existing Manifolding	\$ 30,000				30,000								
New Electrical	\$ 150,000				150,000								
Reservoir Expansion	\$ 100,000					100,000							
Contingencies (20%)	\$ 1,171,000	390,333	390,333	390,333									
Engineering, Legal, & Admin. (15%)	\$ 1,054,000	351,333	351,333	351,333									
Quarterly Expenditure Projection		1,018,333	993,333	998,333	250,000	740,000	180,000	1,160,000	580,000	580,000	540,000	520,000	520,000
				3,010,000			1,170,000			2,320,000			1,580,000
Total Project Cost												\$ 8,080,000	

Figure 2

## **C. Outreach, Community Involvement, and Information Transfer**

### **1. Outreach Efforts**

The Districts will notify all landowners within the district and all neighboring water districts by letter. Additionally, an article will be included in the Friant Waterline describing the project. The Friant Waterline is mailed monthly to water users, landowners, water districts and others representing over 1,000,000 acres of irrigated agriculture in the southeast portion of the San Joaquin Valley. District staff will be available to make a presentation to any interested parties, one possibility being a presentation to specific Delano High School classes regarding the various aspects of water use efficiency.

### **2. Training, Employment and Capacity Building Potential**

Implementation of this project will provide existing District operating staff of four persons with an increased applied knowledge of water use efficiency perspectives and functions. Capacity building potential benefits for these individuals will include computer training, an increased knowledge of SCADA system conceptual and working technology, and thorough knowledge of the revised system operational process having a clear focus upon efficiency.

### 3. Plan for Disseminating Information

The Districts will conduct workshops involving local growers that describe the problematic issues and probable solutions defined within this program. These workshops will provide Growers with the opportunity to identify individual issues and how successful implementation of this project will positively impact their own operations.

### 4. Letter to Local Land Use Entity

Notification to the local land use entity or cooperating agencies is not required. Modifications to the operating system of the Districts will solely impact water users and landowners.

## **D. Qualifications of the Applicants, Cooperators, and Establishment of Partnerships**

### **1. Resume of Project Manager**

**STEVEN C. DALKE, P. E.**

#### **Education**

- B. S. Civil Engineering, Oregon State University
- Specialization in Water Resources Engineering
- Registered Civil Engineer, California

#### **Experience**

1998 to Current

**General Manager** Kern-Tulare Water District  
Rag Gulch Water District

- Responsible for all financial, operational, administrative, and engineering functions of two water districts. Supervises a staff of 6 and reports to two 5-person boards of directors. Served as project manager and project engineer on several major distribution system improvements, including rebuilding portions of three pumping plants, expansion of a reservoir, and installation of several miles of large diameter pipeline. Other related accomplishments include preparation of a water needs assessment, preparation of a groundwater management plan, evaluation of distribution system capacities, and evaluation of future water supplies.

1984 to 1998

**Senior Engineer** Bookman-Edmonston Engineering, Inc.

- Over fourteen years of experience specializing in water resources engineering for agricultural water districts in California and Arizona. Experience includes water supply evaluation, distribution system hydraulics, project economics, energy use, water rights, groundwater management, and environmental documentation.
- Examples of project experience include responsibility for all distribution system, water supply, and groundwater modeling for both the Semitropic Groundwater Banking Program and the Arvin-Edison Groundwater Banking Program.

2. Identify and describe the role of any external cooperators that will be used for this project.

Project design and civil engineering will be performed by Dee Jaspar and Associates, Inc. of Bakersfield, California. The SCADA system requirements and associated costs have undergone a preliminary review by Turnupseed Electric Service Inc. of Tulare, California. Final analysis and installation of the SCADA system will also be performed by Turnupseed Electric Service, Inc. Specifications for construction of the facilities and contract documents will be prepared by the District and the public agency bidding process followed.

3. Provide information about partnerships developed to implement the project.

No other partnerships will be developed to implement the project, other than the previously mentioned description of the Kern-Tulare and Rag Gulch Water Districts operational procedures and methods.

## E. Costs and Benefits

### 1. Budget summary and breakdown.

BUDGET SUMMARY			
Item	Quantity	Unit Cost	Cost
SCADA system		L.S.	\$420,000
<u>Avenue 9 Pumping Plant and Pipeline</u>			
Friant-Kern Canal turnout	1	L.S.	\$200,000
Pumping plant	1,300 hp	800 \$/hp	\$1,040,000
36-inch pipeline	24,000 feet	80 \$/foot	\$1,920,000
27-inch pipeline	8,000 feet	60 \$/foot	\$480,000
Highway crossing	1	L.S.	\$100,000
County road crossing	2	L.S.	\$100,000
Reservoir connection	2	L.S.	<u>\$60,000</u>
			\$3,900,000
<u>Cecil Reservoir Pumping Plant</u>			
Pumping plant	400 hp	800 \$/hp	\$320,000
24-inch pipeline	8,000 feet	50 \$/foot	\$400,000
12-inch pipeline	4,000 feet	20 \$/foot	\$80,000
Interconnections	3	L.S.	<u>\$20,000</u>
			\$820,000
<u>Installation of VFD electrical controls</u>			
Elmo	1	L.S.	\$50,000
6th Booster	1	L.S.	\$25,000
Twin Pipes	1	L.S.	<u>\$30,000</u>
			\$105,000
<u>Improvements to Avenue 24 and Avenue 36 Distribution Systems</u>			
24-inch pipeline	5,200 feet	50 \$/foot	\$260,000
Additional pumps	600 hp	L.S.	\$70,000
Modify existing manifolding	1	L.S.	\$30,000
new electrical	1	L.S.	\$150,000
Reservoir expansion	1	L.S.	<u>\$100,000</u>
			\$610,000
Total Project Cost			\$5,855,000
Contingencies (20%)			<u>\$1,171,000</u>
Subtotal			\$7,026,000
Engineering, Legal & Administration (15%)			<u>\$1,054,000</u>
Total			\$8,080,000

All of the costs in the above table are direct costs. The Districts do not account for employee wages and benefits against various projects.

2. Budget justification.

See above table.

3. Benefit summary and breakdown.

Quantify project benefits include:

- Energy savings are experienced as a result of a reduction in the amount of groundwater pumping required.
- Further energy savings as a result of reduced groundwater pumping lift.
- The amount of costly dry year water supplies that need to be purchased will be reduced as a result of increased groundwater reserves.

In an effort to quantify the value of the above project benefits, operational modeling was conducted assuming a repeat of historic hydrology over the 25-year period from 1976 through 1990. This operational modeling evaluated current conditions and with project conditions.

4. Assessment of costs and benefits.

See attached tables.

**Costs and Benefits of Proposed Project (\$)  
 With \$4.0 Million Grant**

Year	Operations Costs			Debt Service	Net Savings
	Current	Project	Savings		
1966	5,020,000	4,800,978	219,022	312,920	-93,898
1967	5,020,000	5,334,952	-314,952	312,920	-627,872
1968	5,020,000	4,302,715	717,285	312,920	404,365
1969	5,020,000	5,294,977	-274,977	312,920	-587,897
1970	5,020,000	4,529,240	490,760	312,920	177,840
1971	5,020,000	4,242,752	777,248	312,920	464,328
1972	5,020,000	4,693,084	326,916	312,920	13,996
1973	5,020,000	4,832,427	187,573	312,920	-125,347
1974	5,020,000	4,333,189	686,811	312,920	373,891
1975	5,020,000	4,446,452	573,548	312,920	260,628
1976	6,337,363	5,488,044	849,318	312,920	536,398
1977	9,481,083	7,360,349	2,120,734	312,920	1,807,814
1978	5,104,276	5,224,027	-119,751	312,920	-432,671
1979	5,104,276	4,203,510	900,766	312,920	587,846
1980	5,104,276	5,188,077	-83,800	312,920	-396,720
1981	5,182,983	4,706,010	476,973	312,920	164,053
1982	5,108,136	5,169,881	-61,745	312,920	-374,665
1983	5,108,136	5,149,894	-41,757	312,920	-354,677
1984	5,108,136	4,650,656	457,480	312,920	144,560
1985	5,663,634	4,884,479	779,154	312,920	466,234
1986	5,134,942	5,122,364	12,578	312,920	-300,342
1987	6,138,817	5,081,944	1,056,874	312,920	743,954
1988	7,725,064	5,768,684	1,956,380	312,920	1,643,460
1989	5,994,536	5,139,470	855,066	312,920	542,146
1990	7,529,001	5,802,014	1,726,987	312,920	1,414,067
Average	5,600,986	5,030,007	570,980	312,920	258,060

**Notes:**

Operations costs determined from attached tables

Debt service computed as \$4.0 million amortized over 25 years at 6 percent

Project Benefit is computed as operations cost savings less debt service

**Costs and Benefits of Proposed Project (\$)  
 Without Grant**

Year	Operations Costs			Debt Service	Net Savings
	Current	Project	Savings		
1966	5,020,000	4,800,978	219,022	625,840	-406,818
1967	5,020,000	5,334,952	-314,952	625,840	-940,792
1968	5,020,000	4,302,715	717,285	625,840	91,445
1969	5,020,000	5,294,977	-274,977	625,840	-900,817
1970	5,020,000	4,529,240	490,760	625,840	-135,080
1971	5,020,000	4,242,752	777,248	625,840	151,408
1972	5,020,000	4,693,084	326,916	625,840	-298,924
1973	5,020,000	4,832,427	187,573	625,840	-438,267
1974	5,020,000	4,333,189	686,811	625,840	60,971
1975	5,020,000	4,446,452	573,548	625,840	-52,292
1976	6,337,363	5,488,044	849,318	625,840	223,478
1977	9,481,083	7,360,349	2,120,734	625,840	1,494,894
1978	5,104,276	5,224,027	-119,751	625,840	-745,591
1979	5,104,276	4,203,510	900,766	625,840	274,926
1980	5,104,276	5,188,077	-83,800	625,840	-709,640
1981	5,182,983	4,706,010	476,973	625,840	-148,867
1982	5,108,136	5,169,881	-61,745	625,840	-687,585
1983	5,108,136	5,149,894	-41,757	625,840	-667,597
1984	5,108,136	4,650,656	457,480	625,840	-168,360
1985	5,663,634	4,884,479	779,154	625,840	153,314
1986	5,134,942	5,122,364	12,578	625,840	-613,262
1987	6,138,817	5,081,944	1,056,874	625,840	431,034
1988	7,725,064	5,768,684	1,956,380	625,840	1,330,540
1989	5,994,536	5,139,470	855,066	625,840	229,226
1990	7,529,001	5,802,014	1,726,987	625,840	1,101,147
Average	5,600,986	5,030,007	570,980	625,840	-54,860

**Notes:**

Operations costs determined from attached tables

Debt service computed as \$8.0 million amortized over 25 years at 6 percent

Project Benefit is computed as operations cost savings less debt service

### Operational Costs Under Project Conditions

Year	Pumping by Water Users			Surface Deliveries		Shortage		Total Cost (\$)
	Pumping (ac-ft)	Lift (feet)	Cost (\$)	Amount (ac-ft)	Cost (\$)	Amount (ac-ft)	Cost (\$)	
		500						
1966	24,015	498	2,451,728	46,985	2,349,250	0	0	4,800,978
1967	13,000	491	1,307,202	80,555	4,027,750	0	0	5,334,952
1968	13,000	483	1,287,215	60,310	3,015,500	0	0	4,302,715
1969	13,000	476	1,267,227	80,555	4,027,750	0	0	5,294,977
1970	13,000	468	1,247,240	65,640	3,282,000	0	0	4,529,240
1971	13,000	461	1,227,252	60,310	3,015,500	0	0	4,242,752
1972	25,870	459	2,436,584	45,130	2,256,500	0	0	4,693,084
1973	13,000	452	1,204,427	72,560	3,628,000	0	0	4,832,427
1974	13,000	444	1,184,439	62,975	3,148,750	0	0	4,333,189
1975	13,000	437	1,164,452	65,640	3,282,000	0	0	4,446,452
1976	46,710	446	4,273,544	24,290	1,214,500	0	0	5,488,044
1977	48,174	456	4,507,117	0	0	22,826	2,853,232	7,360,349
1978	13,000	449	1,196,277	80,555	4,027,750	0	0	5,224,027
1979	16,020	443	1,454,510	54,980	2,749,000	0	0	4,203,510
1980	13,000	435	1,160,327	80,555	4,027,750	0	0	5,188,077
1981	29,345	436	2,623,260	41,655	2,082,750	0	0	4,706,010
1982	13,000	429	1,142,131	80,555	4,027,750	0	0	5,169,881
1983	13,000	421	1,122,144	80,555	4,027,750	0	0	5,149,894
1984	13,000	414	1,102,156	70,970	3,548,500	0	0	4,650,656
1985	37,340	418	3,201,479	33,660	1,683,000	0	0	4,884,479
1986	13,000	411	1,094,614	80,555	4,027,750	0	0	5,122,364
1987	42,880	418	3,675,944	28,120	1,406,000	0	0	5,081,944
1988	51,414	430	4,530,887	16,140	807,000	3,446	430,797	5,768,684
1989	40,350	436	3,606,970	30,650	1,532,500	0	0	5,139,470
1990	49,305	447	4,515,172	19,000	950,000	2,695	336,842	5,802,014
Average	23,737	446	2,159,372	54,516	2,725,800	1,159	144,835	5,030,007

Assumptions:

Change in pumping lift computed assuming a safe yield of 28,000 acre-feet and a specific yield of 10%

Landowner pumping costs computed assuming 60% efficiency and \$0.12 per kW

Cost of surface water deliveries at \$50 per acre-foot (includes water and power)

Cost of surface water to replace shortages at \$175 per acre-foot (includes water and power)

### Operations Under With Project Conditons

Year	Ground Water (ac-ft)	Surface Water (ac-ft)					Shortage (ac-ft)
		Contract Water Supplies			Total Used	Unused	
		Kern River	CVP	Total			
1966	24,015	23,000	23,985	46,985	46,985	0	0
1967	13,000	27,255	53,300	80,555	58,000	22,555	0
1968	13,000	23,000	37,310	60,310	58,000	2,310	0
1969	13,000	27,255	53,300	80,555	58,000	22,555	0
1970	13,000	23,000	42,640	65,640	58,000	7,640	0
1971	13,000	23,000	37,310	60,310	58,000	2,310	0
1972	25,870	7,820	37,310	45,130	45,130	0	0
1973	13,000	27,255	45,305	72,560	58,000	14,560	0
1974	13,000	23,000	39,975	62,975	58,000	4,975	0
1975	13,000	23,000	42,640	65,640	58,000	7,640	0
1976	46,710	5,635	18,655	24,290	24,290	0	0
1977	48,174	0	0	0	0	0	22,826
1978	13,000	27,255	53,300	80,555	58,000	22,555	0
1979	16,020	23,000	31,980	54,980	54,980	0	0
1980	13,000	27,255	53,300	80,555	58,000	22,555	0
1981	29,345	23,000	18,655	41,655	41,655	0	0
1982	13,000	27,255	53,300	80,555	58,000	22,555	0
1983	13,000	27,255	53,300	80,555	58,000	22,555	0
1984	13,000	23,000	47,970	70,970	58,000	12,970	0
1985	37,340	23,000	10,660	33,660	33,660	0	0
1986	13,000	27,255	53,300	80,555	58,000	22,555	0
1987	42,880	20,125	7,995	28,120	28,120	0	0
1988	51,414	10,810	5,330	16,140	16,140	0	3,446
1989	40,350	22,655	7,995	30,650	30,650	0	0
1990	49,305	345	18,655	19,000	19,000	0	2,695
Average	23,737	20,617	33,899	54,516	46,104	8,412	1,159

#### Assumptions:

Total water demand of 71,000 acre-feet

Maximum distribution system capacity of 58,000 acre-feet (15,000 acre-feet increase)

Maximum groundwater production of 43,000 acre-feet at 500 feet of lift (varies linearly with lift)

### Operational Costs Under Current Conditions

Year	Pumping by Water Users			Surface Deliveries		Shortage		Total Cost (\$)
	Pumping (ac-ft)	Lift (feet)	Cost (\$)	Amount (ac-ft)	Cost (\$)	Amount (ac-ft)	Cost (\$)	
		500						
1966	28,000	500	2,870,000	43,000	2,150,000	0	0	5,020,000
1967	28,000	500	2,870,000	43,000	2,150,000	0	0	5,020,000
1968	28,000	500	2,870,000	43,000	2,150,000	0	0	5,020,000
1969	28,000	500	2,870,000	43,000	2,150,000	0	0	5,020,000
1970	28,000	500	2,870,000	43,000	2,150,000	0	0	5,020,000
1971	28,000	500	2,870,000	43,000	2,150,000	0	0	5,020,000
1972	28,000	500	2,870,000	43,000	2,150,000	0	0	5,020,000
1973	28,000	500	2,870,000	43,000	2,150,000	0	0	5,020,000
1974	28,000	500	2,870,000	43,000	2,150,000	0	0	5,020,000
1975	28,000	500	2,870,000	43,000	2,150,000	0	0	5,020,000
1976	43,000	508	4,473,613	24,290	1,214,500	3,710	649,250	6,337,363
1977	42,365	515	4,469,876	0	0	28,635	5,011,207	9,481,083
1978	28,000	515	2,954,276	43,000	2,150,000	0	0	5,104,276
1979	28,000	515	2,954,276	43,000	2,150,000	0	0	5,104,276
1980	28,000	515	2,954,276	43,000	2,150,000	0	0	5,104,276
1981	29,345	515	3,100,233	41,655	2,082,750	0	0	5,182,983
1982	28,000	515	2,958,136	43,000	2,150,000	0	0	5,108,136
1983	28,000	515	2,958,136	43,000	2,150,000	0	0	5,108,136
1984	28,000	515	2,958,136	43,000	2,150,000	0	0	5,108,136
1985	37,340	520	3,980,634	33,660	1,683,000	0	0	5,663,634
1986	28,000	520	2,984,942	43,000	2,150,000	0	0	5,134,942
1987	41,344	527	4,464,050	28,120	1,406,000	1,536	268,768	6,138,817
1988	40,820	533	4,461,142	16,140	807,000	14,040	2,456,922	7,725,064
1989	40,330	539	4,458,468	30,650	1,532,500	20	3,568	5,994,536
1990	39,869	545	4,456,001	19,000	950,000	12,131	2,123,000	7,529,001
Average	31,616	512	3,331,448	36,981	1,849,030	2,403	420,509	5,600,986

Assumptions:

Change in pumping lift computed assuming a safe yield of 28,000 acre-feet and a specific yield of 10%

Landowner pumping costs computed assuming 60% efficiency and \$0.12 per kW

Cost of surface water deliveries at \$50 per acre-foot (includes water and power)

Cost of surface water to replace shortages at \$175 per acre-foot (includes water and power)

### Operations Under Current Conditions

Year	Ground Water (ac-ft)	Surface Water (ac-ft)					Shortage (ac-ft)
		Contract Water Supplies			Total Used	Unused	
		Kern River	CVP	Total			
1966	28,000	23,000	23,985	46,985	43,000	3,985	0
1967	28,000	27,255	53,300	80,555	43,000	37,555	0
1968	28,000	23,000	37,310	60,310	43,000	17,310	0
1969	28,000	27,255	53,300	80,555	43,000	37,555	0
1970	28,000	23,000	42,640	65,640	43,000	22,640	0
1971	28,000	23,000	37,310	60,310	43,000	17,310	0
1972	28,000	7,820	37,310	45,130	43,000	2,130	0
1973	28,000	27,255	45,305	72,560	43,000	29,560	0
1974	28,000	23,000	39,975	62,975	43,000	19,975	0
1975	28,000	23,000	42,640	65,640	43,000	22,640	0
1976	43,000	5,635	18,655	24,290	24,290	0	3,710
1977	42,365	0	0	0	0	0	28,635
1978	28,000	27,255	53,300	80,555	43,000	37,555	0
1979	28,000	23,000	31,980	54,980	43,000	11,980	0
1980	28,000	27,255	53,300	80,555	43,000	37,555	0
1981	29,345	23,000	18,655	41,655	41,655	0	0
1982	28,000	27,255	53,300	80,555	43,000	37,555	0
1983	28,000	27,255	53,300	80,555	43,000	37,555	0
1984	28,000	23,000	47,970	70,970	43,000	27,970	0
1985	37,340	23,000	10,660	33,660	33,660	0	0
1986	28,000	27,255	53,300	80,555	43,000	37,555	0
1987	41,344	20,125	7,995	28,120	28,120	0	1,536
1988	40,820	10,810	5,330	16,140	16,140	0	14,040
1989	40,330	22,655	7,995	30,650	30,650	0	20
1990	39,869	345	18,655	19,000	19,000	0	12,131
Average	31,616	20,617	33,899	54,516	36,981	17,535	2,403

Assumptions:

Total water demand of 71,000 acre-feet

Maximum distribution system capacity of 43,000 acre-feet

Maximum groundwater production of 43,000 acre-feet at 500 feet of lift (varies linearly with lift)